Semi-Annual Progress Report

January 1998

Mark R. Abbott

College of Oceanic and Atmospheric Sciences

Oregon State University

MODIS Team Member, Contract # NAS5-31360

Task Objectives

The objectives of the last six months were:

- Continue analysis of Hawaii Ocean Time-series (HOT) bio-optical mooring data, and Southern Ocean bio-optical drifter data
- Complete development of documentation of MOCEAN algorithms and software for use by MOCEAN team and GLI team
- Deploy instrumentation during JGOFS cruises in the Southern Ocean
- Participate in test cruise for Fast Repetition Rate (FRR) fluorometer
- Continue chemostat experiments on the relationship of fluorescence quantum yield to environmental factors.
- Continue to develop and expand browser-based information system for in situ bio-optical data

Work Accomplished

Analysis of Field Data

We are continuing to analyze bio-optical data collected at the Hawaii Ocean Time Series mooring as well as data from bio-optical drifters that were deployed in the Southern Ocean. As we noted in our recent quarterly report, a mesoscale feature resulted in an enormous increase in available nitrogen which apparently stimulated phytoplankton productivity. A draft manuscript has now been prepared and is being revised. A second manuscript is also in preparation that explores the vector wind fields derived from NSCAT measurements.

The HOT bio-optical mooring was recovered in December 1997. After retrieving the data, the sensor package was serviced and redeployed. We have begun preliminary analysis of these data, but we have only had the data for 3 weeks. However, all of the data were recovered, and there were no obvious anomalies. We will add second sensor package to the mooring when it is serviced next spring. In addition, Ricardo Letelier is funded as part of the SeaWiFS calibration/validation effort (through a subcontract from the University of Hawaii, Dr. John Porter), and he will be collecting bio-optical and fluorescence data as part of the HOT activity. This will provide additional in situ measurements for MODIS validation.

As noted in the previous quarterly report, we have been analyzing data from three bio-optical drifters that were deployed in the Southern Ocean in September 1996. We presented results on chlorophyll and drifter speed. For the 1998 Ocean Sciences meeting, a paper will be presented on this data set, focusing on the diel variations in fluorescence quantum yield. Briefly, there are systematic patterns in the apparent quantum yield of fluorescence (defined as the slope of the line relating fluorescence/chlorophyll and incoming solar radiation). During some periods, the slope of this line is small (indicating high productivity) whereas during other periods it is much larger (indicating low productivity). These systematic variations appear to be related to changes in the circulation of the Antarctic Polar Front which force nutrients into the upper ocean. A more complete analysis will be provided in the next Quarterly report.

MOCEAN Algorithm Documentation

As part of our joint MODIS/GLI activities, we have developed a complete set of documentation for the MODIS Ocean algorithms. This document would provide an overview of the various component algorithms as well as a brief description of the associated science. Rather than develop a paper document, Jasmine Bartlett (who was tasked with this job) developed a Web document. It can be accessed at http://ricky.oce.orst.edu/MOCP/. Figure 1 shows an overview of the algorithms. Each box is a hyperlink that allows the user to find information about each component.

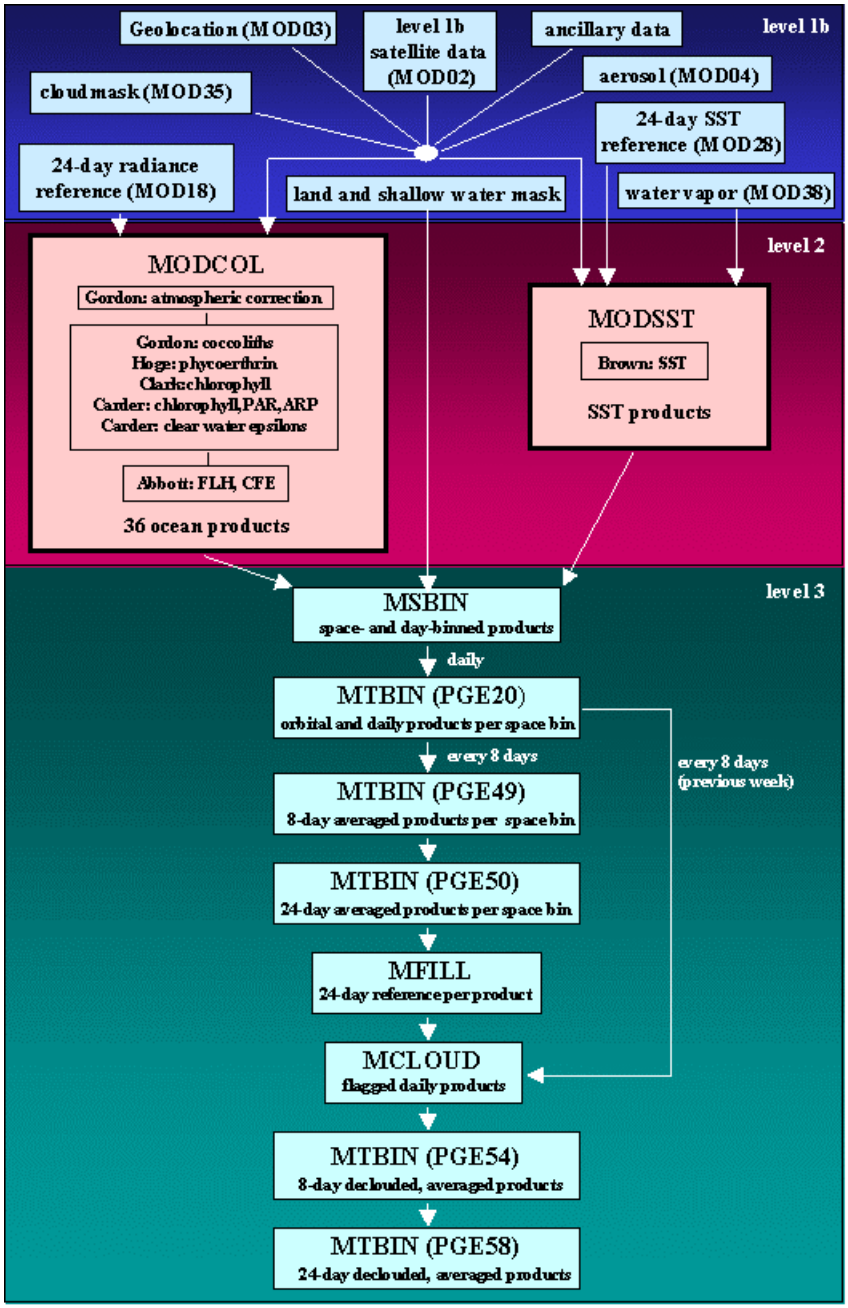


Figure 1. Diagram of linkages between components of MODIS Ocean algorithms

Rather than repeat the information here, we refer interested readers to the Web page for the complete information. The Version 2 MODIS Ocean codes will also be provided to the GLI when the NASDA researchers are ready

Instrumentation in the Southern Ocean

From October-November 1997, we participated in the first survey cruise of the Antarctic Polar Front as part of JGOFS. We deployed 12 moorings, each equipped with a current meter and an irradiance sensor. Six of the moorings also had a conductivity/temperature sensor. These moorings were deployed in a grid with spacing of approximately 30 km between each mooring. We also deployed 10 bio-optical drifters and 10 conventional drifters. Unfortunately, two of the bio-optical drifters failed on deployment, but the vendor has provided us with free replacements for future experiments.

The most recent set of drifter tracks is shown in Figure 2. Note that the main cluster of drifters follows the PF, showing strong divergence near 160°W, associated with the Pacific Antarctic Rise. We expect that primary productivity will be stimulated by the upwelling forced by this divergence. Note also that several drifters are "kicked" out of the PF to the north. This may be an important mechanism for meridional exchange of heat and nutrients.

The Tethered Spectral Radiometer Buoy II was deployed at several stations during the cruise. Chlorophyll values were generally low, given the deep mixing present in the PF during early spring. The TSRB II values agreed quite well with chlorophyll extractions made from near-surface water samples. Sun-stimulated fluorescence was also measured, and these data are now being analyzed.

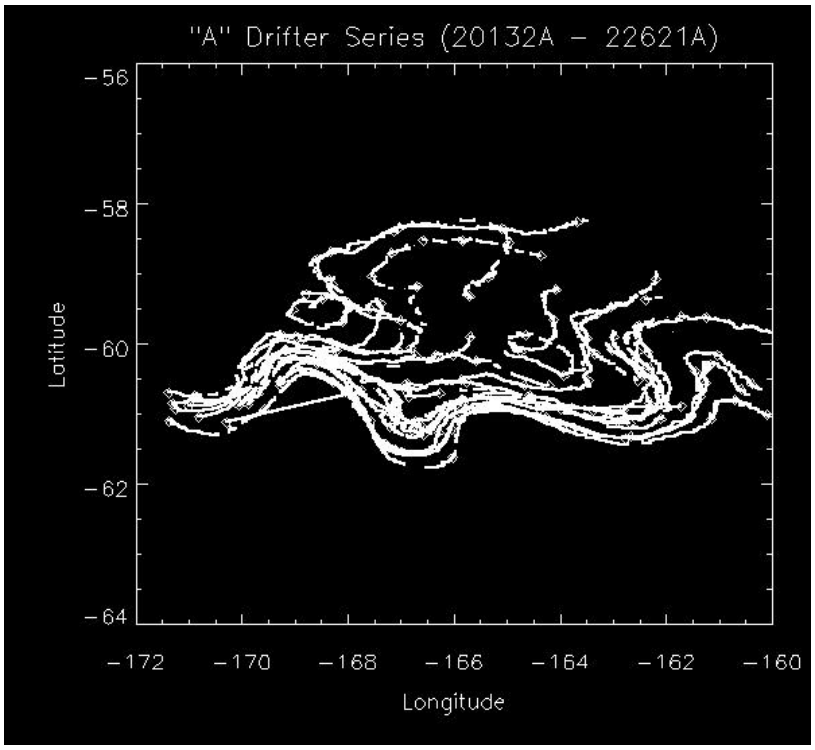


Figure 2. Tracks from drifters deployed in November 1997, as of January 1998.

Figure 3 shows the positions of the moorings and the drifter tracks from the first few days of the deployments. This information is overlain on a map of SST derived from SeaSoar measurements. Note the strong meandering of the flow field, which is associated with upwelling and downwelling. Initially, the drifters pass through a downwelling region which is associated with strong convergence of the drifter tracks. This is followed by upwelling in a divergence region in the meander. This area of upwelling had high chlorophyll levels. The iceberg shown in Figure 3 may have damaged one of our moorings, but we will not know for sure until the recovery cruise in March 1998.

Fast Repetition Rate Fluorometry

The first test with the Fast Repetition Rate (FRR) fluorometer was a qualified success. Although the data were reasonable, there were several technical problems with the operation of the FRR fluorometer. Most notably, the underwater connectors and some elements of the software were poorly designed. The fluorometer was shipped back to Chelsea Instruments in the United Kingdom, so it was not available for the first Polar Front survey cruise.

The FRR fluorometer was returned in December and is now on the R/V Roger Revelle as part of the second JGOFS PF survey. All of the connectors were replaced, and the software has been rewritten. Initial reports are that it is working perfectly, and pigment samples are being collected for HPLC analysis as well as fluorometric analysis.

Chemostat Experiments

We have completed a major redesign of the chemostat that we are borrowing from Dr. Dale Kiefer. This included:

- Redesign of the electronics backplane for the chemostat so that components can be installed and serviced more easily
- Improved electrical fusing and cooling capabilities of the chemostat
- Tested and improved stability of optical components
- Rewrote software to be Win32 compatible to take advantage of real-time capabilities of Windows NT for data acquisition and system control
- Acquired quantum probe for PAR measurements and pH/temperature probe to monitor cultures
- Developed stirring system for phytoplankton cultures
- Developed approach for autoclaving culture media so as to maintain axenic cultures

We have now begun initial tests with the rebuilt chemostat.

EOSDIS Plans

Attached in the Appendix are two papers that have been submitted to the Association of Computing Machinery (ACM) workshop on Java and High Performance Computing. These papers document the status of our advanced browser activity.

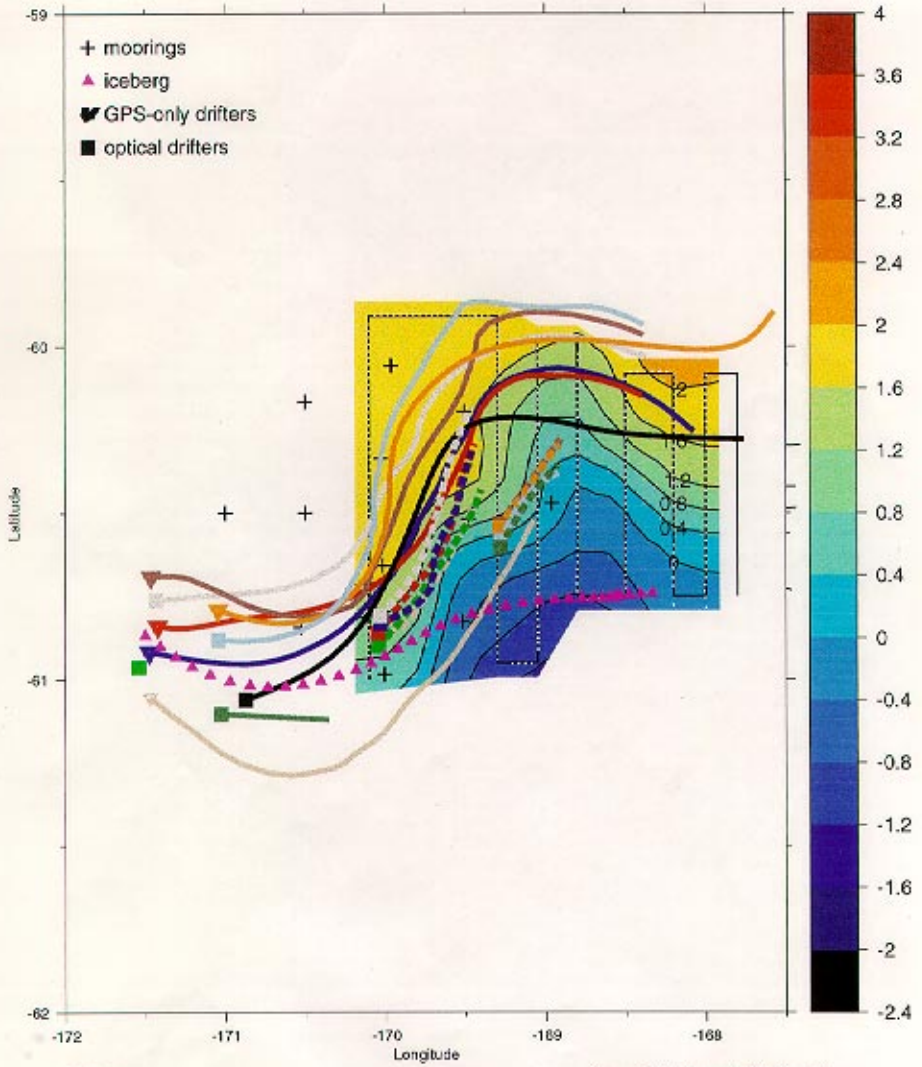
Along with the MODIS Web documentation, we are revising our archive of satellite and in situ data sets. With the release of SeaWiFS data, we are now assembling a data base of both SST and chlorophyll for the Southern Ocean region. This will also include our bio-optical drifter and mooring data.

Anticipated Future Actions

- Retrieve and redeploy bio-optical mooring in Hawaii and continue analysis of bio-optical data
- Analyze data from bio-optical moorings and drifters, TSRB II, and FRR in the Antarctic Polar Frontal Zone
- Continue chemostat experiments on the relationship of fluorescence quantum yield to environmental factors. Establish relationship between fluorescence quantum yield and photosynthetic parameters.
- Continue to develop and expand browser-based information system for in situ bio-optical data.

Sea Surface Temperature (°C) SOJGOFS Survey 1, 15-17 Nov 1997

Drifters from 8-18 November 1997



Preliminary

Oregon State University SeaSoar Group
Oregon State University Mooring Group

Problems and Solutions

The most significant concern remains the apparent inability of EOSDIS to deliver data products at launch. The present approach to cost-savings is based on scaling back hardware acquisitions, which has been shown to be a small fraction of the overall EOSDIS budget. Thus the approach mandated by NASA Headquarters will likely not save money while at the same time causing deep frustration in both the EOS and general Earth science communities. We are concerned that insufficient data will be delivered for algorithm validation as well as analysis in support of future EOS sensor designs.